Final

Site Investigation Report
Range 4A Fog Oil Storage Area, Parcel 123(6)

Fort McClellan
Calhoun County, Alabama

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Executive Summary

In accordance with Contract Number DACA21-96-D-0018, Task Order CK05, IT Corporation (IT) completed a site investigation (SI) at the Range 4A Fog Oil Storage Area, Parcel 123(6), at Fort McClellan, in Calhoun County, Alabama. The SI was conducted to determine whether chemical constituents are present at the site and, if present, whether the concentrations present an unacceptable risk to human health or the environment. The SI at the Range 4A Fog Oil Storage Area, Parcel 123(6), consisted of the sampling and analysis of five surface soil samples, three depositional soil samples, four subsurface soil samples, and five groundwater samples. In addition, five permanent monitoring wells were installed in the saturated zone to facilitate groundwater sample collection and to provide site-specific geological and hydrogeological characterization information.

Chemical analysis of samples collected at the Range 4A Fog Oil Storage Area indicated that metals and volatile organic compounds were detected in the environmental media sampled. To evaluate whether detected constituents pose an unacceptable risk to human health or the environment, the analytical results were compared to human health site-specific screening levels, ecological screening values, and background screening values for Fort McClellan. In addition, a preliminary risk assessment was performed to further characterize the potential threat to human health.

Although Parcel 123(6) is projected for continued use by the Alabama Army National Guard, the SI analytical data were screened against residential human health site-specific screening levels to evaluate the site for possible unrestricted land reuse. The preliminary risk assessment concluded that exposure to site media is unlikely to pose an unacceptable threat to human health in either the proposed reuse scenario or the residential (i.e., unrestricted) reuse scenario.

Three metals (copper, nickel, and zinc) in the surface soils were identified as chemicals of potential ecological concern at the site. The zinc results were within the range of background values determined by Science Applications International Corporation. The copper and nickel results in one surface soil sample location (PR-123-MW03) exceeded the background values. However, the copper result (46.1 mg/kg) and nickel result (31.8 mg/kg) only minimally exceeded their ecological screening values (40.0 mg/kg and 30.0 mg/kg, respectively). These metals are not expected to pose a significant threat to ecological receptors.

Based on the results of the SI, past operations at the Range 4A Fog Oil Storage Area, Parcel 123(6), do not appear to have adversely impacted the environment. The metals and chemical compounds detected in site media do not pose an unacceptable risk to human health and the environment. Therefore, IT recommends "No Further Action" and unrestricted land reuse with regard to hazardous, toxic, and radioactive waste at the Range 4A Fog Oil Storage Area, Parcel 123(6).

1.0 Introduction

The U.S. Army has selected Fort McClellan (FTMC), located in Calhoun County, Alabama, for closure by the Base Realignment and Closure (BRAC) Commission under Public Laws 100-526 and 101-510. The 1990 Base Closure Act, Public Law 101-510, established the process by which U.S. Department of Defense (DOD) installations would be closed or realigned. The BRAC Environmental Restoration Program requires investigation and cleanup of federal properties prior to transfer to the public domain. The U.S. Army is conducting environmental studies of the impact of suspected contaminants at parcels at FTMC under the management of the U.S. Army Corps of Engineers (USACE), Mobile District. The USACE contracted IT Corporation (IT) to perform the site investigation (SI) at the Range 4A Fog Oil Storage Area, Parcel 123(6), under Contract Number DACA21-96-D-0018, Task Order CK05.

This SI report presents specific information and results compiled from the SI, including field sampling and analysis and monitoring well installation activities, conducted at the Range 4A Fog Oil Storage Area, Parcel 123(6).

1.1 Project Description

The Range 4A Fog Oil Storage Area was identified as an area to be investigated prior to property transfer. The site was classified as a Category 6 parcel in the environmental baseline survey (EBS) (Environmental Science and Engineering, Inc. [ESE], 1998). Category 6 parcels are areas where release, disposal, and/or migration of hazardous substances has occurred, but required actions have not yet been implemented.

A site-specific field sampling plan (SFSP) attachment (IT, 2001) and a site-specific safety and health plan (SSHP) attachment were finalized in March 2001. The SFSP and SSHP were prepared to provide technical guidance for sample collection and analysis at the Range 4A Fog Oil Storage Area, Parcel 123(6). The SFSP was used in conjunction with the SSHP as attachments to the installation-wide work plan (IT, 1998) and the installation-wide sampling and analysis plan (SAP) (IT, 2000a). The SAP includes the installation-wide safety and health plan and quality assurance plan.

The SI included fieldwork to collect five surface soil samples, three depositional soil samples, four subsurface soil samples, and five groundwater samples. Data from the field investigation were used to determine whether potential site-specific chemicals are present at the Range 4A Fog Oil Storage Area, Parcel 123(6).

1.2 Purpose and Objectives

The SI program was designed to collect data from site media and to provide a level of defensible data and information in sufficient detail to determine whether chemical constituents are present at the Range 4A Fog Oil Storage Area, Parcel 123(6), at concentrations that present an unacceptable risk to human health or the environment. The conclusions of the SI in Chapter 6.0 are based on the comparison of the analytical results to human health site-specific screening levels (SSSL), ecological screening values (ESV), and background screening values for FTMC. The SSSLs and ESVs were developed by IT as part of the human health and ecological risk evaluations associated with SIs being performed under the BRAC Environmental Restoration Program at FTMC. The SSSLs and ESVs are presented in the *Final Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000b). Background metals screening values are presented in the *Final Background Metals Survey Report, Fort McClellan, Alabama* (Science Applications International Corporation [SAIC], 1998).

Based on the conclusions presented in this SI report, the BRAC Cleanup Team will decide either to propose "No Further Action" at the site or to conduct additional work at the site.

1.3 Site Description and History

Range 4A Fog Oil Storage Area, Parcel 123(6), is located in the north-central portion of Pelham Range, (Figure 1-1). The area has been designed for storage of fog oil used to generate smoke for training exercises at FTMC and Pelham Range. Based on interpretation of aerial photographs, the area is believed to have been in use since at least 1964. The Fog Oil Storage Area consists of two concrete structures: a 15- by 15-foot drum handling area and a 60- by 60-foot loading and storage area (Figure 1-2). Both the drum handling area and the loading and storage area, are fenced. Each concrete structure is equipped with drains connected to an oil/water separator (OWS) and an underground storage tank (UST). The drains are designed to collect spilled oil and precipitation (U.S. Army Center for Health Promotion and Preventive Medicine [CHPPM], 1999).

The loading and storage area is surrounded by a 5-foot-high concrete berm and elevated containment areas. The concrete pad is sloped to divert spilled oil and precipitation to a floor drain, connected to the OWS. Seams in the concrete pad were once reported to be leaking and may have led to seepage of fog oil into the ground beneath the pad. The seams in the concrete pad have been subsequently resealed (ESE, 1998).

Originally, drums of fog oil were stored on bare soil with earthen berms. The surface soil was reportedly stained with oil from the storage and handling activities. The loading and storage area was designed to store approximately 75,000 gallons of fog oil. However, in 1986, quantities greater than 75,000 gallons were observed. The loading and storage area was modified to its current configuration sometime between 1986 and 1990 (CHPPM, 1999).

Historically, drums were stored on their sides in the elevated containment areas. Approximately 150 30-gallon drums were stored at the facility in June 1999 and to be removed from the facility by October 1999, because of the closure of FTMC (CHPPM, 1999). Three half-full 30-gallon drums were found during a site visit conducted by IT on November 6, 2000. In addition to fog oil, clean rags, used rags, dry sweep, and small amounts of fuel were stored at the Range 4A Fog Oil Storage Area (CHPPM, 1999).

The drum handling area, located north of the loading and storage area, is a 2-foot-deep concrete pit covered with a metal grate, connected to the OWS via underground piping. Design drawings indicate that the drum handling area was originally a sandpit (CHPPM, 1999). During site visits were conducted by Weston in June 1990, oil spills were observed in and around the staging area. The soils outside of the original drum staging area were noticeably stained (Roy F. Weston, Inc., 1990).

FTMC has received noncompliance notifications for discharges of lead and total organic carbon from the OWS Outfall DSN002 at the facility. However, the discharge limits were incorrectly calculated and were recalculated following an evaluation by the Alabama Department of Environmental Management (ADEM) in December 1994 (CHPPM, 1999). Since December 1994, lead and total organic carbon concentrations have been within discharge limits. The quarterly effluent sampling was conducted by the FTMC Directorate of Environment (ESE, 1998).

In 1986, the U.S. Army Environmental Hygiene Agency determined that the OWS was functioning improperly. The OWS was replaced in 1994 using coalescing plates and is designed to continuously discharge water. The current OWS contains two sumps located at the downslope end of the loading and storage area. Waste oil from the OWS is discharged to the UST. The OWS is cleaned-out periodically and the wastes disposed through a Defense Reutilization Marketing Office contract (CHPPM, 1999). One groundwater observation well is located adjacent to the UST on the east side. The depth of this well is 8.9 feet from the top of well casing. During a site inspection conducted by IT on November 6, 2000 the depth to water was measured to be 2.5 feet from the top of the well casing. This observation well appears to be installed in the backfill material around the UST. No construction details or historical data were available for this well.

Parcel 123(6) is approximately 200 feet long (north to south) by 170 feet wide (east to west) and covers approximately 0.77 acres. The land surface slopes gently from the northwest to the southeast across the parcel, with a range in elevation from approximately 625 to 615 feet above mean sea level.

2.0 Previous Investigations

An EBS was conducted by ESE to document current environmental conditions of all FTMC property (ESE, 1998). The study was to identify sites that, based on available information, have no history of contamination and comply with DOD guidance for fast-track cleanup at closing installations. The EBS also provides a baseline picture of FTMC properties by identifying and categorizing the properties by seven criteria:

1. Areas where no storage, release, or disposal of hazardous substances or petroleum products has occurred (including no migration of these substances from adjacent areas).
2. Areas where only release or disposal of petroleum products has occurred.
3. Areas where release, disposal, and/or migration of hazardous substances has occurred, but at concentrations that do not require a removal or remedial response.
4. Areas where release, disposal, and/or migration of hazardous substances has occurred, and all removal or remedial actions to protect human health and the environment have been taken.
5. Areas where release, disposal, and/or migration of hazardous substances has occurred, and removal or remedial actions are underway, but all required remedial actions have not yet been taken.
6. Areas where release, disposal, and/or migration of hazardous substances has occurred, but required actions have not yet been implemented.
7. Areas that are not evaluated or require additional evaluation.

The EBS was conducted in accordance with Community Environmental Response Facilitation Act (CERFA) protocols (CERFA-Public Law 102-426) and DOD policy regarding contamination assessment. Record searches and reviews were performed on all reasonably available documents from FTMC, ADEM, the U.S. Environmental Protection Agency (EPA) Region IV, and Calhoun County, as well as a database search of CERCLA-regulated substances, petroleum products, and Resource Conservation and Recovery Act-regulated facilities. Available historical maps and aerial photographs were reviewed to document historical land uses. Personal and telephone interviews of past and present FTMC employees and military personnel were conducted. In addition, visual site inspections were conducted to verify conditions of specific property parcels.

The Range 4A Fog Oil Storage Area, Parcel 123(6), was identified as a CERFA Category 6 site. This CERFA category identifies the recorded release of fog oil onto the ground at the drum handling area and the loading and storage area at the site. The Range 4A Fog Oil Storage Area requires additional evaluation to determine the environmental condition of the parcel.

3.0 Current Site Investigation Activities

This chapter summarizes SI activities conducted by IT at the Range 4A Fog Oil Storage Area, Parcel 123(6), including unexploded ordnance (UXO) avoidance activities, environmental sampling and analysis, and groundwater monitoring well installation activities.

3.1 UXO Avoidance

UXO avoidance was performed at the Range 4A Fog Oil Storage Area, Parcel 123(6), following methodology outlined in Section 4.1.7 of the SAP (IT, 2000a). IT UXO personnel used a Schonstedt Heliflux Magnetic Locator to perform a surface sweep of the parcel prior to site access. After the parcel was cleared for access, sample locations were cleared using a Foerster Ferex Electromagnetic Detector, following procedures outlined in Section 4.1.7.3 of the SAP (IT, 2000a).

3.2 Environmental Sampling

The environmental sampling performed during the SI at the Range 4A Fog Oil Storage Area, Parcel 123(6), included the collection of surface and depositional soil samples, subsurface soil samples, and groundwater samples for chemical analysis. The sample locations were determined by observing site physical characteristics during a site walkover and by reviewing historical documents pertaining to activities conducted at the site. The sample locations, media, and rationale are summarized in Table 3-1. Sampling locations are shown on Figure 3-1. Samples were submitted for laboratory analysis of site-related parameters listed in Section 3.4.

3.2.1 Surface and Depositional Soil Sampling

Five surface soil samples and three depositional soil samples were collected at the Range 4A Fog Oil Storage Area, Parcel 123(6), as shown on Figure 3-1. Soil sampling locations and rationale are presented in Table 3-1. Soil sample designations and quality assurance/quality control samples are listed in Table 3-2. Sampling locations were determined in the field by the on-site geologist based on UXO avoidance activities, sampling rationale, presence of surface structures, and site topography.

Sample Collection. Surface and depositional soil samples were collected from the upper 1 foot of soil using a stainless-steel hand auger, following the methodology specified in Section 4.9.1.1 of the SAP (IT, 2000a). The samples were collected by first removing surface debris (e.g., rocks and vegetation) from the immediate sample area. The soil was then collected with the sampling device and screened with a photoionization detector (PID) in accordance with

Section 4.7.1.1 of the SAP (IT, 2000a). The soil fraction for volatile organic compound (VOC) analysis was collected directly from the sampler using three EnCore® samplers. The remaining portion of the sample was transferred to a clean stainless-steel bowl, homogenized, and placed in the appropriate sample containers. Sample collection logs are included in Appendix A. The samples were analyzed for the parameters listed in Table 3-2 using methods outlined in Section 3.4.

3.2.2 Subsurface Soil Sampling

Subsurface soil samples were collected from four soil borings at the Range 4A Fog Oil Storage Area, Parcel 123(6), as shown on Figure 3-1. A subsurface soil sample was not collected at a fifth location (PR-123-MW05) because direct-push technology (DPT) refusal was encountered at 1-foot below ground surface (bgs). Subsurface soil sampling locations and rationale are presented in Table 3-1. Subsurface soil sample designations, depths, and analytical parameters are listed in Table 3-2. Soil boring sampling locations were determined in the field by the on-site geologist based on UXO avoidance activities, sampling rationale, presence of surface structures, and site topography. IT contracted Environmental Services Network, Inc., a DPT subcontractor, to assist in subsurface soil sample collection.

Sample Collection. Subsurface soil samples were collected from soil borings at depths greater than 1 foot bgs in the unsaturated zone. The soil borings were advanced and samples collected using the DPT sampling procedures specified in Section 4.9.1.1 of the SAP (IT, 2000a). Sample collection logs are included in Appendix A. The samples were analyzed for the parameters listed in Table 3-2 using methods outlined in Section 3.4.

Subsurface soil samples were collected continuously until DPT sampler refusal or groundwater was encountered. Samples were field screened using a PID in accordance with Section 4.7.1.1 of the SAP (IT, 2000a) to measure for volatile organic vapors. The sample displaying the highest reading was selected and sent to the laboratory for analysis; however, at those locations where PID readings were not greater than background, the deepest sample interval above the saturated zone was submitted for analysis. The soil fraction for VOC analysis was collected directly from the sampler using three EnCore samplers. The remaining portion of the sample was transferred to a clean stainless-steel bowl, homogenized, and placed in the appropriate sample containers. The on-site geologist constructed a detailed boring log for each soil boring (Appendix B).

At the completion of soil sampling, boreholes were abandoned with bentonite pellets and hydrated with potable water following borehole abandonment procedures summarized in Appendix B of the SAP (IT, 2000a).

3.2.3 Well Installation

Five permanent groundwater monitoring wells were installed in the saturated zone at the Range 4A Fog Oil Storage Area, Parcel 123(6), to collect groundwater samples for laboratory analysis. The groundwater sampling locations are shown on Figure 3-1. Table 3-3 summarizes construction details of the wells installed at the Range 4A Fog Oil Storage Area, Parcel 123(6). The well construction logs are included in Appendix B.

IT contracted Miller Drilling, Inc. to install the permanent residuum monitoring wells at the DPT soil boring locations. The monitoring wells were to be installed at the DPT soil boring locations using a hollow-stem auger rig. However, due to difficult drilling and auger refusal before reaching groundwater at monitoring well locations PR-123-MW02 and PR-123-MW05, the decision was made by the IT site manger to install the monitoring wells using air rotary drilling techniques. The wells were installed following procedures outlined in Section 4.7 and Appendix C of the SAP (IT, 2000a). At monitoring well locations PR-123-MW02 and PR-123-MW05, the borehole was augered to the completion depth of the DPT boring and samples were collected from that depth to the bottom of the borehole. A 2-foot-long, 2-inch inside diameter (ID) carbon steel split-spoon sampler was driven at 5-foot intervals to collect residuum for observing and describing lithology. Where split-spoon refusal was encountered, the auger was advanced to auger refusal. The on-site geologist logging the boreholes continued the lithological log for each borehole from the depth of split-spoon refusal to the bottom borehole by logging the drill cuttings. The drill cuttings from both the hollow-stem auger and air rotary rigs were logged to determine lithologic changes and the approximate depth of groundwater encountered during drilling. This information was used to determine the optimal placement of the monitoring well screen interval and to provide site-specific geological and hydrogeological information. The boring log for each borehole is included in Appendix B.

Upon reaching the target depth in each borehole, a 20-foot length of 2-inch ID, 0.010-inch continuous slot, Schedule 40 polyvinyl chloride (PVC) screen with a 3-inch PVC end cap was placed through the auger to the bottom of the borehole. The screen and end cap were attached to 2-inch ID, flush-threaded Schedule 40 PVC riser. A filter pack consisting of Number 1 filter sand (environmentally safe, clean fine sand, sieve size 20 to 40) was tremied around the well screen to approximately 6 feet above the top of the well screen as the augers were removed. A bentonite seal, consisting of approximately 4 feet of bentonite pellets, was placed immediately on top of the filter sand and hydrated with potable water. At wells where the bentonite seal was installed below the water table surface, the bentonite pellets were allowed to hydrate in the groundwater. The bentonite seal placement and hydration followed procedures in Appendix C of the SAP (IT, 2000a). Bentonite-cement grout was tremied into the annular space of the well from the top of the bentonite seal to the ground surface. After adequate time was allowed for the bentonite-cement grout to set, the PVC well riser was cutoff at or near the ground surface and a locking well cap was placed securely on top of the riser. A steel flush-mount, bolt-down, traffic-bearing, monitoring well cover was placed over the riser and locking cap and secured in place with a concrete pad.

The wells were developed by surging and pumping with a 2-inch-diameter submersible pump in accordance with methodology outlined in Section 4.8 and Appendix C of the SAP (IT, 2000a). The submersible pump used for well development was moved in an up-and-down fashion to encourage any residual well installation materials to enter the well. These materials were then pumped out of the well in order to re-establish the natural hydraulic flow conditions. Development was performed until the water turbidity was less than or equal to 20 nephelometric turbidity units (NTU), for a maximum of 8 hours, or until the well had been pumped dry and allowed to recharge three times. The well development logs are included in Appendix C.

3.2.4 Water Level Measurements

The depth to groundwater was measured in the permanent wells at the site on January 7, 2002, following procedures outlined in Section 4.18 of the SAP (IT, 2000a). Depth to groundwater was measured with an electronic water level meter. The meter probe and cable were cleaned between uses at each well following decontamination methodology presented in Section 4.10 of the SAP (IT, 2000a). Measurements were referenced to the top of each well casing. A summary of groundwater level measurements for the Range 4A Fog Oil Storage Area, Parcel 123(6), is presented in Table 3-4.

3.2.5 Groundwater Sampling

A groundwater sample was collected from each of the five permanent wells installed at the site. The groundwater sampling locations are shown on Figure 3-1. The groundwater sampling locations and rationale are listed in Table 3-1. The groundwater sample designations and quality assurance/quality control samples are listed in Table 3-5.

Sample Collection. Groundwater samples from the IT installed wells were collected using a blatter pump equipped with Teflon™ tubing following the procedures outlined in Section 4.9.1.4

of the SAP (IT, 2000a). Groundwater was sampled after purging a minimum of three well volumes and after field parameters (temperature, pH, dissolved oxygen, specific conductivity, oxidation-reduction potential, and turbidity) stabilized. Field parameters were measured using a calibrated water-quality meter. Field parameter readings are summarized in Table 3-6. Sample collection logs are included in Appendix A. The samples were analyzed for the parameters listed in Table 3-5 using methods outlined in Section 3.4. The groundwater sample from the existing SAIC well was collected using a bladder pump. The procedures outlined in Section 4.9.1.4 of the SAP (IT, 2000a) were attempted, however, turbidity remained elevated after extensive purging and the sample was decanted.

3.3 Surveying of Sample Locations

Sample locations were surveyed using global positioning system survey techniques described in Section 4.3 of the SAP and conventional civil survey techniques described in Section 4.19 of the SAP (IT, 2000a). Horizontal coordinates were referenced to the U.S. State Plane Coordinate System, Alabama East Zone, North American Datum of 1983. Elevations were referenced to the North American Vertical Datum of 1988. Horizontal coordinates and elevations are included in Appendix D.

3.4 Analytical Program

Samples collected during the SI were analyzed for various chemical parameters based on potential site-specific chemicals and on EPA, ADEM, FTMC, and USACE requirements. Samples collected at the Range 4A Fog Oil Storage Area, Parcel 123(6), were analyzed for the following parameters:

- Target analyte list metals – EPA Method 6010B/7000
- Target compound list VOCs – EPA Method 8260B
- Target compound list semivolatile organic compounds (SVOC) – EPA Method 8270C

The samples were analyzed using EPA SW-846 methods, including Update III Methods where applicable, as presented in Table 6-1 in Appendix B of the SAP (IT, 2000a).

3.5 Sample Preservation, Packaging, and Shipping

Sample preservation, packaging, and shipping followed requirements specified in Section 4.13.2 of the SAP (IT, 2000a). Sample containers, sample volumes, preservatives, and holding times for the analyses required in this SI are listed in Table 5-1 of Appendix B of the SAP (IT, 2000a). Sample documentation and chain-of-custody records were completed as specified in Section 4.13 of the SAP (IT, 2000a).

Completed analysis request and chain-of-custody records (Appendix A) were secured and included with each shipment of sample coolers to EMAX Laboratories, Inc. in Torrance, California.

3.6 Investigation-Derived Waste Management and Disposal

Investigation-derived waste (IDW) was managed and disposed as outlined in Appendix D of the SAP (IT, 2000a). The IDW generated during the SI at the Range 4A Fog Oil Storage Area, Parcel 123(6), was segregated as follows:

- Drill cuttings
- Purge water from well development, sampling activities, and decontamination fluids
- Personal protective equipment (PPE).

Solid IDW was stored at the site in lined roll-off bin prior to characterization and final disposal. Solid IDW was characterized using toxicity characteristic leaching procedure analyses. Based on the results, drill cuttings and PPE generated during the SI at the Range 4A Fog Oil Storage Area, Parcel 123(6), were disposed as nonregulated waste at the Industrial Waste Landfill on the Main Post of FTMC.

Liquid IDW was stored in a portable frac tank staged at Range J pending waste characterization. Liquid IDW was characterized by VOC, SVOC, and metals analyses. Based on the analyses, liquid IDW was discharged as nonregulated waste to the FTMC wastewater treatment plant on the Main Post.

3.7 Variances/Nonconformances

Two variances to the SFSP were recorded during completion of the SI at the Range 4A Fog Oil Storage Area, Parcel 123(6). These variances did not alter the intent of the investigation or the sampling rationale presented in Table 4-2 of the SFSP (IT, 2001). The variances to the SFSP are summarized in Table 3-7 and included in Appendix E.

3.8 Data Quality

The field sample analytical data are presented in tabular form in Appendix F. The field samples were collected, documented, handled, analyzed, and reported in a manner consistent with the SI work plan; the FTMC SAP and installation-wide quality assurance plan; and standard, accepted methods and procedures. Data were reported and evaluated in accordance with Corps of Engineers South Atlantic Savannah Level B criteria (USACE, 1994) and the stipulated requirements for the generation of definitive data (Section 3.1.2 of Appendix B of the SAP [IT, 2000a]). Chemical data were reported via hard-copy data packages by the laboratory using Contract Laboratory Program-like forms.

Data Validation. The reported analytical data were validated in accordance with EPA National Functional Guidelines by Level III criteria. The data validation results are summarized in a quality assurance report, which includes the data validation summary report (Appendix G). Selected results were rejected or otherwise qualified based on the implementation of accepted data validation procedures and practices. These qualified parameters are highlighted in the report. The validation-assigned qualifiers were added to the FTMC IT Environmental Management System™ database for tracking and reporting. The qualified data were used in the comparison to the SSSLs and ESVs. Rejected data (assigned an "R" qualifier) were not used in the comparison to the SSSLs and ESVs.

The data presented in this report, except where qualified, meet the principal data quality objective for this SI.

4.0 Site Characterization

Subsurface investigations performed at the Range 4A Fog Oil Storage Area, Parcel 123(6), provided soil, bedrock, and groundwater data used to characterize the geology and hydrogeology of the site.

4.1 Regional and Site Geology

4.1.1 Regional Geology

Calhoun County includes parts of two physiographic provinces, the Piedmont Upland Province and the Valley and Ridge Province. The Piedmont Upland Province occupies the extreme eastern and southeastern portions of the county and is characterized by metamorphosed sedimentary rocks. The generally accepted range in age of these metamorphics is Cambrian to Devonian.

The majority of Calhoun County, including the Main Post of FTMC, lies within the Appalachian fold-and-thrust structural belt (Valley and Ridge Province), where southeastward-dipping thrust faults with associated minor folding are the predominant structural features. The fold-and-thrust belt consists of Paleozoic sedimentary rocks that have been asymmetrically folded and thrust-faulted, with major structures and faults striking in a northeast-southwest direction.

Northwestward transport of the Paleozoic rock sequence along the thrust faults has resulted in the imbricate stacking of large slabs of rock, referred to as thrust sheets. Within an individual thrust sheet, smaller faults may splay off the larger thrust fault, resulting in imbricate stacking of rock units within the individual thrust sheet (Osborne and Szabo, 1984). Geologic contacts in this region generally strike parallel to the faults, and repetition of lithologic units is common in vertical sequences. Geologic formations within the Valley and Ridge Province portion of Calhoun County have been mapped by Warman and Causey (1962), Osborne and Szabo (1984), and Moser and DeJarnette (1992) and vary in age from Lower Cambrian to Pennsylvanian.

The basal unit of the sedimentary sequence in Calhoun County is the Cambrian Chilhowee Group. The Chilhowee Group consists of the Cochran, Nichols, Wilson Ridge, and Weisner Formations (Osborne and Szabo, 1984) but in Calhoun County is either undifferentiated or divided into the Cochran and Nichols Formations and an upper, undifferentiated Wilson Ridge and Weisner Formation. The Cochran is composed of poorly sorted arkosic sandstone and conglomerate with interbeds of greenish-gray siltstone and mudstone. Massive to laminated greenish-gray and black mudstone makes up the Nichols Formation, with thin interbeds of siltstone and very fine-grained sandstone (Osborne et al., 1988). These two formations are mapped only in the eastern part of the county.

The Wilson Ridge and Weisner Formations are undifferentiated in Calhoun County and consist of both coarse-grained and fine-grained clastics. The coarse-grained facies appears to dominate the unit and consists primarily of coarse-grained, vitreous quartzite and friable, fine- to coarse-grained, orthoquartzitic sandstone, both of which locally contain conglomerate. The fine-grained facies consists of sandy and micaceous shale and silty, micaceous mudstone, which are locally interbedded with the coarse clastic rocks. The abundance of orthoquartzitic sandstone and quartzite suggests that most of the Chilhowee Group bedrock in the vicinity of FTMC belongs to the Weisner Formation (Osborne and Szabo, 1984).

The Cambrian Shady Dolomite overlies the Weisner Formation northeast, east, and southwest of the Main Post and consists of interlayered bluish-gray or pale yellowish-gray sandy dolomitic limestone and siliceous dolomite with coarsely crystalline, porous chert (Osborne et al., 1989). A variegated shale and clayey silt have been included within the lower part of the Shady Dolomite (Cloud, 1966). Material similar to this lower shale unit was noted in core holes drilled by the Alabama Geologic Survey on FTMC (Osborne and Szabo, 1984). The character of the Shady Dolomite in the FTMC vicinity and the true assignment of the shale at this stratigraphic interval are still uncertain (Osborne, 1999).

The Rome Formation overlies the Shady Dolomite and locally occurs to the northwest and southeast of the Main Post, as mapped by Warman and Causey (1962) and Osborne and Szabo (1984), and immediately to the west of Reilly Airfield (Osborne and Szabo, 1984). The Rome Formation consists of variegated, thinly interbedded grayish-red-purple mudstone, shale, and siltstone and greenish-red and light gray sandstone, with locally occurring limestone and dolomite. The Conasauga Formation overlies the Rome Formation and occurs along anticlinal axes in the northeastern portion of Pelham Range (Warman and Causey, 1962; Osborne and Szabo, 1984) and the northern portion of the Main Post (Osborne et al., 1997). The Conasauga Formation is composed of dark-gray, finely to coarsely crystalline, medium- to thick-bedded dolomite with minor shale and chert (Osborne et al., 1989).

Overlying the Conasauga Formation is the Knox Group, which is composed of the Copper Ridge and Chepultepec dolomites of Cambro-Ordovician age. The Knox Group is undifferentiated in Calhoun County and consists of light medium gray, fine to medium crystalline, variably bedded to laminated, siliceous dolomite and dolomitic limestone that weather to a chert residuum

(Osborne and Szabo, 1984). The Knox Group underlies a large portion of the Pelham Range area.

The Ordovician Newala and Little Oak Limestones overlie the Knox Group. The Newala Limestone consists of light to dark gray, micritic, thick-bedded limestone with minor dolomite. The Little Oak Limestone consists of dark gray, medium- to thick-bedded, fossiliferous, argillaceous to silty limestone with chert nodules. These limestone units are mapped as undifferentiated at FTMC and in other parts of Calhoun County. The Athens Shale overlies the Ordovician limestone units. The Athens Shale consists of dark gray to black shale and graptolitic shale with localized interbedded dark gray limestone (Osborne et al., 1989). These units occur within an eroded "window" in the uppermost structural thrust sheet at FTMC and underlie much of the developed area of the Main Post.

Other Ordovician-aged bedrock units mapped in Calhoun County include the Greensport Formation, Colvin Mountain Sandstone and Sequatchie Formation. These units consist of various siltstones, sandstones, shales, dolomites, and limestones and are mapped as one, undifferentiated unit in some areas of Calhoun County. The only Silurian-age sedimentary formation mapped in Calhoun County is the Red Mountain Formation. This unit consists of interbedded red sandstone, siltstone, and shale with greenish-gray to red silty and sandy limestone.

The Devonian Frog Mountain Sandstone consists of sandstone and quartzitic sandstone with shale interbeds, dolomudstone, and glauconitic limestone (Osborne et al., 1988). This unit locally occurs in the western portion of Pelham Range.

The Mississippian Fort Payne Chert and the Maury Formation overlie the Frog Mountain Sandstone and are composed of dark to light gray limestone with abundant chert nodules and greenish-gray to grayish-red phosphatic shale, with increasing amounts of calcareous chert toward the upper portion of the formation (Osborne and Szabo, 1984). These units occur in the northwestern portion of Pelham Range. Overlying the Fort Payne Chert is the Floyd Shale, also of Mississippian age, which consists of thin-bedded, fissile, brown to black shale with thin intercalated limestone layers and interbedded sandstone. Osborne and Szabo (1984) reassigned the Floyd Shale, which was mapped by Warman and Causey (1962) on the Main Post of FTMC, to the Ordovician Athens Shale based on fossil data.

The Pennsylvanian Parkwood Formation overlies the Floyd Shale and consists of a medium to dark gray, silty, clay shale and mudstone with interbedded light to medium gray, very fine to fine grained, argillaceous, micaceous sandstone. Locally the Parkwood Formation also contains beds of medium to dark gray argillaceous, bioclastic to cherty limestone and beds of clayey coal up to a few inches thick (Raymond et al., 1988). In Calhoun County, the Parkwood Formation is generally found within a structurally complex area known as the Coosa deformed belt. In the deformed belt, the Parkwood Formation and Floyd Shale are mapped as undifferentiated because their lithologic similarity and significant deformation make it impractical to map the contact (Thomas and Drahovzal, 1974; Osborne et al., 1988). The undifferentiated Parkwood Formation and Floyd Shale are found throughout the western quarter of Pelham Range.

The Jacksonville thrust fault is the most significant structural geologic feature in the vicinity of the Main Post of FTMC, both for its role in determining the stratigraphic relationships in the area and for its contribution to regional water supplies. The trace of the fault extends northeastward for approximately 39 miles between Bynum, Alabama, and Piedmont, Alabama. The fault is interpreted as a major splay of the Pell City fault (Osborne and Szabo, 1984). The Ordovician sequence that makes up the Eden thrust sheet is exposed at FTMC through an eroded window, or "fenster," in the overlying thrust sheet. Rocks within the window display complex folding, with the folds being overturned and tight to isoclinal. The carbonates and shales locally exhibit well-developed cleavage (Osborne and Szabo, 1984). The FTMC window is framed on the northwest by the Rome Formation, north by the Conasauga Formation, northeast, east, and southwest by the Shady Dolomite, and southeast and southwest by the Chilhowee Group (Osborne et al., 1997). Two small klippen of the Shady Dolomite, bounded by the Jacksonville fault, have been recognized adjacent to the Pell City fault at the FTMC window (Osborne et al., 1997).

The Pell City fault serves as a fault contact between the bedrock within the FTMC window and the Rome and Conasauga Formations. The trace of the Pell City fault is also exposed approximately nine miles west of the FTMC window on Pelham Range, where it traverses northeast to southwest across the western quarter of Pelham Range. The trace of the Pell City fault marks the boundary between the Pell City thrust sheet and the Coosa deformed belt.

The eastern three-quarters of Pelham Range is located within the Pell City thrust sheet, while the remaining western quarter of Pelham is located within the Coosa deformed belt. The Pell City thrust sheet is a large-scale thrust sheet containing Cambrian and Ordovician rocks. It is relatively less structurally complex than the Coosa deformed belt (Thomas and Neathery, 1982). The Pell City thrust sheet is exposed between the traces of the Jacksonville and Pell City faults along the western boundary of the FTMC window, and along the trace of the Pell City fault on Pelham Range (Thomas and Neathery, 1982; Osborne et al., 1988). The Coosa deformed belt is a narrow (approximately 5 to 20 miles wide) northeast-to-southwest-trending linear zone of complex structure (approximately 90 miles in length) consisting mainly of thin imbricate thrust slices. The structure within these imbricate thrust slices is often internally complicated by small-scale folding and additional thrust faults (Thomas and Drahovzal, 1974).

4.1.2 Site Geology

Soil at the Range 4A Fog Oil Storage Area is mapped as the Clarksville Fullerton stony loam. This soil is a strongly acid, well-drained soil that has developed in the residuum of cherty limestone. The color of the surface soil is dark brown to grayish-brown. The subsurface soil ranges from red to strong brown and consists of a cherty, silt clay loam. Pieces of chert and limestone, three to eight inches or more in diameter are found throughout the soil. Runoff and infiltration of this soil are medium, permeability is rapid, and the capacity for available moisture is moderate (U.S. Department of Agriculture, 1961).

Bedrock at the site is mapped as the undifferentiated Cambrian/Ordovician Knox Group (Osborne et al., 1988). The Knox Group consists of light medium gray, fine to medium crystalline, variably bedded to laminated, siliceous dolomite and dolomitic limestone that weather to a chert residuum (Osborne and Szabo, 1984).

Based on the geologic data collected during the SI, the soil from ground surface to 2 to 4 feet bgs consisted of a light brown to brown, silty, gravelly sand. Between approximately 4 and 18 feet bgs, the soil consisted of a yellowish to reddish-brown sandy, gravelly clay. Below 18 feet bgs, the geology consisted of a reddish-brown to white silty, gravelly clay interspersed with intervals of weathered, cherty limestone. The gravel encountered at this site consisted of angular pieces of chert and weathered limestone. The soil and the weathered bedrock encountered during drilling activities are consistent with the mapped Clarksville Fullerton stony loam and the bedrock of the Knox Group.

4.2 Site Hydrology

4.2.1 Surface Hydrology

Precipitation in the form of rainfall averages about 54 inches annually in Anniston, Alabama, with infiltration rates annually exceeding evapotranspiration rates (U.S. Department of Commerce, 1998). The major surface water feature at Pelham Range is Cane Creek, and its associated tributaries drain almost all of Pelham Range. However, tributaries to the

Tallassehatchee Creek drain small parts of the northern portion of Pelham Range. Cane Creek flows east to west across the range and empties into the Coosa River, located just west of Pelham Range. Tallassehatchee Creek is also an east to west following tributary to the Coosa River that is located north of Pelham Range. Other surface water features at Pelham Range include Lake Contreras, Willet Springs, and the Blue Hole (SAIC, 2000).

The land surface at Parcel 123(6) gently slopes from northwest to southeast across the parcel, with a range in elevation from 625 to 615 feet above mean sea level. Surface runoff from the site appears to collect in three surface drainage features located within the parcel. These drainage features channel surface runoff to the southeast, eventually emptying into an intermittent stream located approximately 600 feet southeast of the site. This intermittent flows to the northeast, eventually emptying into the Tallassehatchee Creek.

4.2.2 Hydrogeology

Static groundwater levels were measured in the permanent residuum monitoring wells at the Range 4A Fog Oil Storage Area, Parcel 123(6), on January 7, 2002. Depth-to-groundwater measurements were taken from the top of casing, following procedures outlined in Section 4.18 of the SAP (IT, 2000b). A potentiometric surface map was constructed for the residuum water-bearing unit and is provided on Figure 4-1. Static groundwater elevations are presented in Table 3-4. Groundwater elevation data revealed a local groundwater mound beneath the Fog Oil Storage Area. Groundwater flow beneath the western portion of the parcel is to the west and groundwater flow beneath the eastern portion of the parcel is to the east (Figure 4-1). The horizontal hydraulic gradient across the parcel is calculated to be approximately 0.10 feet per foot.

5.0 Summary of Analytical Results

The results of the chemical analysis of samples collected at the Range 4A Fog Oil Storage Area, Parcel 123(6), indicate that metals and VOCs were detected in the site media. SVOCs were not detected in sampled site media. To evaluate whether the detected constituents present an unacceptable risk to human health and the environment, the analytical results were compared to the human health SSSLs and ESVs for FTMC. The SSSLs and ESVs were developed by IT for human health and ecological risk evaluations as part of the ongoing SIs being performed under the BRAC Environmental Restoration Program at FTMC.

Metals concentrations exceeding the SSSLs and ESVs were subsequently compared to metals background screening values to determine if the metals concentrations are within natural background concentrations (SAIC, 1998). Summary statistics for background metals samples collected at FTMC are included in Appendix H.

The following sections and Tables 5-1 through 5-3 summarize the results of the comparison of detected constituents to the SSSLs, ESVs, and background screening values. Complete analytical results are presented in Appendix F.

5.1 Surface and Depositional Soil Analytical Results

Five surface soil samples and three depositional soil samples were collected for chemical analysis at the Range 4A Fog Oil Storage Area, Parcel 123(6). Surface and depositional soil samples were collected from the upper 1 foot of soil at the locations shown on Figure 3-1. Analytical results were compared to residential human health SSSLs, ESVs, and metals background screening values as presented in Table 5-1.

Metals. Twenty metals were detected in the surface and depositional soil at Range 4A Fog Oil Storage Area, Parcel 123(6). The concentrations of five metals (aluminum, arsenic, iron, manganese, and thallium) exceed SSSLs. However, these concentrations were below their respective background concentrations.

The concentrations of nine metals (aluminum, arsenic, chromium, copper, iron, manganese, nickel, vanadium, and zinc) exceeded ESVs. Of these metals, only copper (one sample location), nickel (one sample location), and zinc (five sample locations) also exceeded their respective background concentrations. With the exception of copper and nickel results, both at sample location PR-123-MW03, the concentrations of these metals were within the range of background values established by SAIC (1998) (Appendix H).

Volatile Organic Compounds. Four VOCs (2-butanone, acetone, methylene chloride, and toluene) were detected in the surface and depositional soil samples collected at the site. Two of the acetone and all of the methylene chloride results were flagged with a "B" data qualifier, signifying that the compounds were also detected in an associated laboratory or field blank. The cumulative VOC concentrations in the surface and depositional soil samples ranged from 0.0456 milligrams per kilogram (mg/kg) to 0.652 mg/kg. The VOC concentrations in surface and depositional soils were below SSSLs and ESVs.

5.2 Subsurface Soil Analytical Results

Four subsurface soil samples were collected for chemical analysis at the Range 4A Fog Oil Storage Area, Parcel 123(6). Subsurface soil samples were collected at depths greater than 1 foot bgs at the locations shown on Figure 3-1. Analytical results were compared to residential human health SSSLs and metals background screening values, as presented in Table 5-2.

Metals. Nineteen metals were detected in the subsurface soil collected at Parcel 123(6). The concentrations of seven metals (aluminum, arsenic, chromium, iron, manganese, thallium, and vanadium) exceeded SSSLs. Of these metals only arsenic, manganese, and thallium at one sample location (PR-123-MW01) exceeded their respective background concentrations. With the exception of arsenic, these metals concentrations were within the range of background values established by SAIC (1998) (Appendix H). The arsenic result at PR-123-MW01 (66.30 mg/kg) exceeded the range of background arsenic values (0.77 to 38.0 mg/kg).

Volatile Organic Compounds. Two VOCs (acetone and methylene chloride) were detected in all four subsurface soil samples collected at the site. All of the acetone results were flagged with the "J" data qualifier, signifying that the compound was positively identified but the concentrations were estimated. All of the methylene chloride results were flagged with a "B" data qualifier, signifying that this compound was also detected in an associated laboratory or field blank sample. The VOC concentrations in the subsurface soil were below SSSLs.

5.3 Groundwater Analytical Results

Five groundwater samples were collected for chemical analysis at the Range 4A Fog Oil Storage Area, Parcel 123(6), at the locations shown on Figure 3-1. Analytical results were compared to residential human health SSSLs and metals background screening values, as presented in Table 5-3.

Metals. Nineteen metals were detected in the groundwater samples collected at the Range 4A Fog Oil Storage Area, Parcel 123(6). All nineteen metals were detected in the groundwater sample from PR-123-MW01, in which nine metals concentrations exceeded SSSLs. The number and high concentrations of metals in the sample was most likely related to the extremely high turbidity (> 1,000 NTUs). The effect of high turbidity on metals concentrations in groundwater has been previously demonstrated in a groundwater resampling study conducted by IT at FTMC (IT, 2000c) (Appendix I). A reanalysis of the groundwater sample taken from PR-123-MW01 for metals was undertaken at the lab after the non-dissolved solids were decanted from the sample. Only ten metals were detected in the decanted sample, of which just three exceeded SSSLs.

Excluding the first analysis of the groundwater water sample taken from at PR-123-MW01, only twelve metals were detected in the groundwater sampled from Range 4A Fog Oil Storage Area, Parcel 123(6). All of the results for three metals (cobalt, nickel, and silver) were flagged with a "B" data qualifier, signifying that the metals were also detected in an associated laboratory or field blank. Four metals (aluminum, iron, manganese, and nickel) exceeded SSSLs. With the exception of aluminum at one sample location (PR-123-MW03) and manganese at three sample locations (PR-123-MW01, PR-123-MW02, and PR-123-MW05), the concentrations of these metals were below their respective background concentrations. However, the aluminum and manganese results were within the range of background values established by SAIC (1998) (Appendix H).

5.4 Preliminary Risk Assessment

A preliminary risk assessment (PRA) was performed to further characterize the potential threat to human health from exposure to environmental media at the Range 4A Fog Oil Storage Area, Parcel 123(6). The PRA approach was developed at the request of the EPA and ADEM to provide a fast and inexpensive estimation of risk for relatively simple sites. It was derived from the streamlined risk assessment (SRA) protocol developed for FTMC and documented in the installation-wide work plan (IT, 1998). A PRA is a simplified version of an SRA, differing primarily in that the maximum detected concentration (MDC) rather than an estimate of average is adopted as the source-term concentration (STC) for use in the risk assessment. Documentation is not included herein to save space and time. However, a PRA cannot be less conservative (protective) than an SRA and is generally more protective. The PRA for Parcel 123(6) is included in Appendix J. It discusses the environmental media of interest, selection of site-related chemicals, selection of chemicals of potential concern (COPC), risk characterization, and conclusions.

The foundation of the SRA (and the PRA) is the SSSL, which incorporates all the exposure and toxicological assumptions and precision of a full-blown baseline risk assessment. SSSLs are receptor-, medium-, and chemical-specific risk-based concentrations that are used to screen media to select COPCs and to characterize risk, i.e., compute the incremental lifetime cancer risk (ILCR) and hazard index (HI) for noncancer effects associated with exposure to the media at the site.

The SSSLs applied to a given site represent the most highly exposed receptor scenario for each of several plausible uses for the site. Both the residential and National Guardsperson receptor scenarios were evaluated for Parcel 123(6). COPCs were selected from the site-related chemicals identified in the previous sections by comparing the MDC of the site-related chemical with the appropriate SSSL. Chemicals that were identified as not being site-related were dropped from further consideration because their presence was not attributed to site activities. The COPCs selected in this manner are chemicals in each medium that may contribute significantly to cancer or to the potential for noncancer effects. As noted above, the MDC was selected as the STC for use in risk characterization. ILCR and HI values were estimated for each COPC in each medium and were summed to obtain total ILCR and HI values for each receptor.

Arsenic in subsurface soil was identified as the only "risk driver," yielding unacceptable ILCR and HI values for residential exposure. There is, however, no plausible way for exposure to subsurface soil without simultaneous exposure to surface soil. Therefore, the surface and subsurface soil data sets were combined and a new STC was calculated for arsenic. Values for combined surface and subsurface soil demonstrate that exposure to combined surface and subsurface soil is unlikely to result in unacceptable cancer risk or adverse noncancer health effects for the resident receptor or for any other standard receptor scenario.

6.0 Summary, Conclusions, and Recommendations

IT, under contract to USACE, completed an SI at the Range 4A Fog Oil Storage Area, Parcel 123(6), at FTMC in Calhoun County, Alabama. The SI was conducted to determine whether chemical constituents are present at the site and, if present, whether the concentrations pose an unacceptable risk to human health or the environment. The SI at the Range 4A Fog Oil Storage Area, Parcel 123(6), consisted of the sampling and analysis of five surface soil samples, three depositional soil samples, four subsurface soil samples, and five groundwater samples. In addition, five permanent monitoring wells were installed in the saturated zone to facilitate groundwater sample collection and to provide site-specific geological and hydrogeological characterization information.

Chemical analysis of samples collected at the site indicates that metals and VOCs were detected in the environmental media sampled. SVOCs were not detected in the site media. Analytical results were compared to the SSSLs and ESVs for FTMC. The SSSLs and ESVs were developed by IT for human health and ecological risk evaluations as part of the ongoing SIs being performed under the BRAC Environmental Restoration Program at FTMC. Additionally, metals concentrations exceeding SSSLs and ESVs were compared to media-specific background screening values (SAIC, 1998). A PRA was also performed to further characterize the potential threat to human health.

Although the Range 4A Fog Oil Storage Area, Parcel 123(6), is projected for continued use by the Alabama Army National Guard, the SI analytical data were screened against residential human health SSSLs to evaluate the site for possible unrestricted land reuse. Base on the results of the SI, the site can be released for unrestricted use, requiring no further action.

Three metals (copper, nickel, and zinc) in the surface soils were identified as chemicals of potential ecological concern at the site. The zinc results were within the range of background values determined by SAIC. The copper and nickel results in one surface soil sample location (PR-123-MW03) exceeded the background values. However, the copper result (46.1 mg/kg) and nickel result (31.8 mg/kg) only minimally exceeded their ESVs (40.0 mg/kg and 30.0 mg/kg, respectively). These metals are not expected to pose a significant threat to ecological receptors.

Based on the results of the SI, past operations at the Range 4A Fog Oil Storage Area, Parcel 123(6), do not appear to have adversely impacted the environment. The metals and chemical compounds detected in site media do not pose an unacceptable risk to human health and the environment. Therefore, IT recommends "No Further Action" and unrestricted land reuse with regard to hazardous, toxic, and radioactive waste at the Range 4A Fog Oil Storage Area, Parcel 123(6).

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